08-10-00

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PATENT

Attorney Docket No. TRW(VSSIM)4784

Assistant Commissioner for Patents
Washington, D.C. 20231

NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of Inventor(s): Harold R. Blomquist, Bryan W. Shirk, Timothy A. Swann

For (title): **IGNITION MATERIAL FOR AN IGNITER**

Enclosed are:

1. Papers Required for Filing Date Under 37 CFR 1.53(b):

17 Pages of specification

1 Pages Abstract

5 Pages of claims

1 Sheets of drawing

☒ formal (Figs. -)

☐ informal

In addition to the above papers there is also attached: Information Disclosure Statement, PTO 1449 form w/references (5)

CERTIFICATION UNDER 37 CFR 1.10

I hereby certify that this New Application Transmittal and the documents referred to as enclosed therein are being deposited with the United States Postal Service on this date August 9, 2000 in an envelope as "Express Mail Post Office to Addressee" Mailing Label Number EK956006803 addressed to the: Assistant Commissioner for Patents, Washington D.C.

Deborah Denn
(Type or print name of person mailing paper)

[signature]
(Signature of person mailing paper)

2. **Declaration or oath:**

☒ Enclosed (Executed)

☐ Not Enclosed.

3. **Language:**

☒ English

☐ Non-English

☐ A verified English translation of the

  ☐ specification and claims

  ☐ declaration

is attached.

4. **Assignment:**

☒ An assignment of the invention to TRW Inc.

  ☒ is attached.

  ☐ will follow

5. **Certified Copy:**

Certified copy (ies) of application (s)

(Country)	(Appln. No.)	(Filed)
(Country)	(Appln. No.)	(Filed)
(Country)	(Appln. No.)	(Filed)

from which priority is claimed

☐ is attached

☐ will follow

EXPRESS MAIL NO. EK956006803

6. **Fee Calculation:**
(Small entity filing fee is 50% normal fee)

CLAIMS AS FILED					
Number Filed		Number Extra		Rate	Basic Fee $ 690.00
Total Claims	19	-20 =	X	$ 18.00	-0-
Independent Claims	1	- 3 =	X	$ 78.00	-0-
Multiple dependent claim(s), if any			+	$260.00	

☐ Amendment canceling extra claims enclosed

☐ Amendment deleting multiple dependencies enclosed

☐ Fee for extra claims is not being paid at this time

Filing Fee Calculation $690.00

7. **Small Entity Statement**

☐ Verified statement that this is a filing by a **small entity** under 37 CFR 1.9 and 1.27

(Must be enclosed to get small entity filing fee reduction)

8. **Fee Payment Being Made At This Time:**

Enclosed:

☒ basic filing fee $690.00

☒ assignment recordal fee $40.00

☐ for processing an application with a specification in a non-English language $____

Total fees enclosed $730.00

9. **Method of Payment Fees:**

☒ check in the amount of $ 730.00 **enclosed.**

☐ The Commissioner is hereby authorized to charge any **DEFICIENCY** in the filing fees for this application to our Deposit Account No. 20-0090.

10. **Instructions As to Overpayment:**

☒ refund

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IGNITION MATERIAL FOR AN IGNITER

Field of the Invention

The present invention relates to an igniter, and particularly relates to an ignition material for an igniter for inflating an inflatable vehicle occupant protection device.

Background of the Invention

An inflatable vehicle occupant protection device, such as an air bag, is inflated by inflation gas provided by an inflator. The inflator typically contains ignitable gas generating material. The inflator further includes an igniter to ignite the gas generating material.

The igniter contains a charge of ignition material. The igniter also contains a bridgewire that is supported in a heat transferring relationship with the ignition material. When the igniter is actuated, an actuating level of electric current is directed through the bridgewire in the igniter. This causes the bridgewire to become resistively heated sufficiently to ignite the

ignition material. The ignition material then produces ignition products that, in turn, ignite the gas generating material.

Summary of the Invention

The present invention is an electrically actuatable igniter. The electrically actuatable igniter comprises a pair of electrodes. A heating element is electrically connected between said electrodes. An ignition material is in contact with the heating element. The ignition material comprises a metal powder and an oxidizer that exothermically reacts with the metal powder. The metal powder includes macro-agglomerates of metal particles. The metal particles have an average diameter less than about 0.1 µm and have an oxide layer that prevents contact of the particles with the oxidizer. The ignition material deflagrates when the heating element is heated to a temperature of at least about 250°C.

Brief Description of the Drawings

The foregoing and other features of the invention will become more apparent to one skilled in the art upon consideration of the following description of the invention and the accompanying drawings, in which:

Fig. 1 is a schematic view of a vehicle occupant protection apparatus embodying the present invention; and

Fig. 2 is an enlarged sectional view of a part of the apparatus of Fig. 1.

Description of the Preferred Embodiment

Referring to Figure 1, an apparatus 10 embodying the present invention includes an inflator 14 and an inflatable vehicle occupant protection device 26. The inflator 14 contains a gas generating material 16. The gas generating material 16 is ignited by an igniter 24 operatively associated with the gas generating material 16. Electric leads 20 and 22 convey electric current to and from the igniter 24. The electric current is conveyed to the igniter 24 through a crash sensor 18 from a power source (not shown). The crash sensor 18 is responsive to vehicle deceleration indicative of a collision. A gas flow means 28, such as an opening in the inflator 14, conveys gas, which is generated by combustion of the gas generating material 16, to the vehicle occupant protection device 26.

A preferred vehicle occupant protection device 26 is an air bag that is inflatable to help protect a vehicle occupant in the event of a collision. Other vehicle

occupant protection devices that can be used with the present invention are inflatable seat belts, inflatable knee bolsters, inflatable air bags to operate knee bolsters, inflatable head liners, and inflatable side curtains.

Referring to Fig. 2, the igniter 24 has a central axis 39 and a pair of axially projecting electrodes 40 and 42. A heating element in the form of a bridgewire 44 is electrically connected between the electrodes 40 and 42 within the igniter 24. An ignition material 48 is contained within the igniter 24. The ignition material surrounds and is in contact with the bridgewire 44 so that the ignition material is in a heat receiving relationship with the bridgewire 44.

The igniter 24 further includes a header 50, a charge cup 52 and a casing 54. The header 50 is a metal part, preferably made of 304L steel, with a generally cylindrical body 60 and a circular flange 62 projecting radially outward from one end of the body 60. A cylindrical outer surface 64 of the body 60 has a recessed portion 66 defining a circumferentially extending groove 68.

The charge cup 52 also is a metal part, and has a cylindrical side wall 70 received in a tight fit over the

body 60 of the header 50. The side wall 70 of the charge cup 52 is fixed and sealed to the body 60 of the header 50 by a circumferentially extending weld 72. The charge cup 52 is further secured to the header 50 by a plurality of circumferentially spaced indented portions 74 of the side wall 70 that are crimped radially inward into the groove 68. In this arrangement, the side wall 70 and a circular end wall 76 of the charge cup 52 together contain and hold the ignition material 48 in a heat transferring relationship with the bridgewire 44. A plurality of thinned portions (not shown) of the end wall 76 function as stress risers that rupture under the influence of the combustion products generated by the ignition material 48.

The casing 54 is a sleeve-shaped plastic part that is shrink-fitted onto the header 50 and the charge cup 52 so as to insulate and partially encapsulate those parts. An opening 79 in the casing 54 allows ignition products escaping through the ruptured thinned portions of the charge cup 52 to exit the igniter 24.

The header 50 has a pair of cylindrical inner surfaces 80 and 82 that are axially aligned and together define a central passage 84 extending fully through the header 50. The first electrode 40 has an inner end portion 86 extending along the entire length of the

central passage 84. A pair of axially spaced apart glass seals 88 and 90 surround the first electrode 40 in the central passage 84, and electrically insulate the first electrode 40 from the header 50 and from the electrode 42. Preferably, the glass seals 88 and 90 are formed from a barium alkali silicate glass. The electrode 42, at one end 43, seats against the header 50 in direct contact with the header 50.

The bridgewire 44 extends from a radially extending surface 41 of the first electrode 40 to a radially extending surface 51 of the header 50. The bridgewire 44 has flattened opposite end portions 100 and 102, which are fixed to the electrode surface 41 and the header surface 51 by electrical resistance welds 104 and 106, respectively. The opposite end portions 100 and 102 of the bridgewire 44 become flattened under the pressure applied by the welding electrodes (not shown) that are used to form the resistance welds 104 and 106. The bridgewire 44 thus has an unflattened major portion 108 extending between the opposite end portions 100 and 102. The major portion 108 of the bridgewire 44 is bent so that the major portion 108 lies in a plane spaced from the plane of the opposite end portions 100 and 102 and from a

radially extending surface 89 of the first glass seal 88 and the header surface 51.

The bridgewire 44, in one embodiment, is formed from a high resistance metal alloy. A preferred metal alloy is "NICHROME", a nickel-chromium alloy. Other suitable alloys for forming a high resistance bridgewire 44 include platinum-tungsten and 304L steel. An electrical current flow in the bridgewire 44 resistively heats the bridgewire to temperature of about 250°C to about 400°C. The heat generated by the bridge wire 44 is sufficient to ignite the ignition material 48.

A semi-conductor bridge (SCB) may be used in place of the bridgewire 44. A semi-conductor bridge consists of dissimilar conductive materials such as a thick resistive film on a ceramic substrate, a thin resistive film deposited on a ceramic substrate, or a semi-conductor junction diffusion doped onto a silicon substrate. A current flow in the semi-conductor bridge heats the semi-conductor bridge to a temperature of about 250°C to about 400°C, which is sufficient to ignite the ignition material 48. Examples of semi-conductor bridges include: a substrate that is formed of ceramic material such as dense alumina (Al_2O_3), beryllia (BeO), or steatite and an alloy

such as nickel-chrome, phosphorous-chrome, or tantalum nitride on the substrate.

In accordance with the present invention, the ignition material 48 is a pyrotechnic composition that deflagrates when the bridgewire 44 is heated to a temperature of at least about 250°C. By deflagrate, it is meant that the ignition material 48 undergoes an exothermic chemical reaction producing a vigorous evolution of heat and sparks or flame that move through the ignition material 48 at a speed less than the speed of sound.

The ignition material 48 of the present invention comprises a fuel and an oxidizer. The fuel is a metal powder that exothermically reacts with the oxidizer upon actuation of the igniter 24. The metal powder of the present invention is produced by electro-explosion of a metal wire under controlled atmospheric condition. The electro-explosion of metal wire to produce a powdered metal is well known in the art. In the process, a metal wire is placed in an inert atmosphere and connected in an electrical circuit that includes a power source. The wire is pulsed with an electrical current sufficient to increase the temperature of the metal wire to a

temperature of about 10,000°C to about 20,000°C. At a temperature of about 10,000°C to about 20,000°C, the metal wire vaporizes and forms metal plasma. The pulse of electric current, which vaporizes the metal wire, also produces an electromagnetic field that initially contains the metal plasma. The vapor pressure of the metal plasma overcomes the electromagnetic field, and the metal plasma explodes into an aerosol of metal particles.

The metal particles so formed by explosion of the metal wire have an essentially spherical configuration and have an average particle size less than about 100 nm. Preferably, the metal particles have an average particle size from about 20 nm to about 100 nm.

The metal particles agglomerate into macro-agglomerates having the consistency of a metal powder. The macro-agglomerates have an average diameter of about 1 μm to about 2 μm. Preferably, the macro-agglomerates have an average diameter of about 1 μm.

Metal powders formed by the electro-explosion of a metal wire react more readily with the oxidizer of the present invention than metal powders formed by conventional methods such as milling. The rate of reaction of the metal powder with the oxidizer is

increased because metal powders formed by electro-explosion of metal wires have a greater surface area than metal powders formed by conventional methods. Metal powders formed by electro-explosion have a surface area of about 15 square meters per gram, which is several orders of magnitude greater than metal powders formed by conventional methods. Moreover, it is believed that metal powders formed by electro-explosion have a strained crystal structure. This strained crystal structure, during reaction of the metal powder with the oxidizer, undergoes exothermic rearrangement. The exothermic rearrangement of the crystal structure generates heat, which in turn facilitate reaction of metal powder formed by electro-explosion and the oxidizer.

Preferred metal powders formed by electro-explosion are electro-exploded aluminum powder, electro-exploded titanium powder, electro-exploded copper powder, electro-exploded zinc powder, and electro-exploded yttrium powder. These electro-exploded metal powders are commercially available from Argonide Co.

These electro-exploded metal powders are preferred because, upon reaction with the oxidizer of the present invention, they form a non-toxic and environmentally benign ignition product. Moreover, these electro-exploded

metal powders, when combined with the oxidizer of present invention, form ignition materials that do not thermally decompose at temperatures up to about 120° and do not deflagrate when exposed to external stress such as impact.

The metal particles that form the electro-exploded aluminum powder, electro-exploded titanium powder, electro-exploded copper powder, electro-exploded zinc powder, and electro-exploded yttrium powder are naturally coated, upon exposure to air, with a thin metal oxide layer of, respectively, aluminum oxide, titanium oxide, copper oxide, zinc oxide, and yttrium oxide. The coating of metal oxide is about 5 nm to about 30 nm thick. The coating of metal oxide does not readily react with the oxidizer of the present invention. As a result, the coating of metal oxide acts as a buffer to prevent the metal particles from contacting and reacting with oxidizer during processing of the ignition material and storage of the ignition material. Thus, ignition materials comprising electro-exploded aluminum powder, electro-exploded titanium powder, electro-exploded copper powder, electro-exploded zinc powder, and electro-exploded yttrium powder may be processed using conventional processing techniques.

A more preferred metal powder is electro-exploded aluminum powder. Electro-exploded aluminum powder comprises macro-agglomerates of aluminum particles. The aluminum particles have an average particle size of about 20 nm to about 100 nm. The macro-agglomerates have an average diameter of about 1 μm.

The amount of metal powder in the ignition material is that amount necessary to achieve sustained, rapid deflagration of the ignition material upon ignition. Preferably, the amount of fuel is from about 15% to about 75% by weight of the ignition material. More preferably, the amount of metal powder is from about 25% to about 50% by weight of the ignition material.

The oxidizer of the present invention may be any oxidizing material that readily reacts with the metal powder of the present invention and produces an ignition product that is non-toxic and environmentally benign. A preferred oxidizer is an inorganic salt oxidizer. Examples of inorganic salt oxidizers that can be used in an ignition material of the present invention are alkali metal nitrates such as sodium nitrate and potassium nitrate, alkaline earth metal nitrates such as strontium nitrate and barium nitrate, alkali metal perchlorates such as sodium perchlorate, potassium perchlorate, and lithium

perchlorate, alkaline earth metal perchlorates, alkali metal chlorates such as sodium chlorate, lithium chlorate and potassium chlorate, alkaline earth metal chlorates such as magnesium chlorate and calcium chlorate, ammonium perchlorate, ammonium nitrate, and mixtures thereof.

Other oxidizers that may be used in the present invention are metal oxides, peroxides, and superoxides such as ferric oxide (Fe_2O_3), cupric oxide (CuO), manganese dioxide (MnO_2), and molybdenum trioxide (MoO_3).

The oxidizer is incorporated into the ignition material in the form of particles. The sensitivity of the ignition material to thermal decomposition and external stress such as impact, as well as the burning rate of the ignition material, are dependent on the average particle size of the oxidizer. If the particle size of the oxidizer incorporated in the ignition material is less than about 0.1 μm, the ignition material can auto-ignite at temperatures below about 250°C or upon exposure to external stress such as shock. If the average particle size of the oxidizer incorporated in the ignition material is greater than about 100 μm, the burn rate of the ignition material will not be effective to ignite the gas generating material and actuate the vehicle occupant

protection apparatus. Preferably, the oxidizer incorporated in the ignition material has an average particle size of about 1 µm to about 30 µm.

The amount of oxidizer in the ignition material is that amount necessary to achieve sustained, rapid deflagration of the ignition material upon ignition. Preferably, the amount of oxidizer in the ignition material is about 25% to about 85% by weight of the ignition material. More preferably, the amount of oxidizer in the ignition material is about 50% to about 75% by weight of the ignition material.

In a preferred embodiment of the present invention, the ignition material is prepared by adding the metal powder and the particulate oxidizer to a conventional mixing device, without the addition of any processing aids such as solvents or binders. The metal powder and particulate oxidizer are then mixed until the metal powder and particulate oxidizer are uniformly dispersed. The ignition material so formed is pressed into the ignition cup 52 of the igniter 24.

Alternatively, ignition material can be prepared by admixing the metal powder and the particulate oxidizer with a binder. Preferably, the binder is an oxidizable organic material. Examples of oxidizable organic materials

are organic polymers such as cellulose esters, cellulose ethers, vinyl polymers, acrylates, and methacryalates, phenolaldehydes, polyamides, natural and synthetic rubber, and natural resins.

The amount of binder mixed with the powdered metal and particulate oxidizer is that amount sufficient to form a homogenous mixture with the metal powder and particulate oxidizer without impairing the sensitivity of the ignition material to ignition by the heating element. Preferably, the amount of binder mixed the powdered metal and the particulate oxidizer is from about 1% to about 5% by weight of the ignition material.

The powdered metal, particulate oxidizer, and binder are mixed by a conventional mixture until a homogeneous mixture is formed. The homogeneous mixture of powdered metal, particulate oxidizer, and binder is pressed into the ignition cup 52 and allowed to dry.

When the igniter 24 is actuated, an actuating level of electric current is directed through the bridgewire 44 between the electrodes 40 and 42. As the actuating level of the electric current is conducted through the bridgewire 44, the bridgewire 44 is heated to a temperature between about 250°C and about 400°C. The heat is transferred directly to the ignition material 48. The

particles of ignition material adjacent to the bridgewire 44 ignite, resulting in deflagration of the ignition material. Deflagration of the ignition material produces ignition products, including heat, hot gases and hot particles at a temperature of about 3000°C to about 6000°C. The ignition products are spewed outward from the igniter 24 and ignite the gas generating material.

Example

This Example illustrates preparation of an ignition droplet in accordance with the present invention.

25 mg of electro-exploded aluminum powder and 75 mg of particulate potassium chlorate are added to a mixing device ("POWERGEN" No. 35 manufactured by Powergen Inc.). The electro-exploded aluminum powder is commercially available from Argonide Co. under the trade name ALEX. The electro-exploded aluminum powder comprises macro-agglomerates of aluminum particles. The aluminum particles have an average diameter of about 50 nm. The macro-agglomerates have an average diameter of about 1 μm. The particles of the potassium chlorate have an average diameter of about 5 microns.

The electro-exploded aluminum powder and potassium chlorate are blended until the electro-exploded aluminum

powder is uniformly dispersed with the particles of potassium chlorate.

The ignition material so formed does not thermally decompose at temperatures up to about 120°C and is resistant ignition by impact. The ignition material produces an ignition product upon deflagration that has a temperature greater than about 3000°C.

From the above description of the invention, those skilled in the art will perceive improvements, changes and modifications. Such improvements, changes and modifications within the skill of the art are intended to be covered by the appended claims.

Having described the invention, the following is claimed:

1. An electrically actuatable igniter comprising:

a pair of electrodes;

a heating element electrically connected between said electrodes; and

an ignition material in contact with said heating element, said ignition material comprising a metal powder and an oxidizer that exothermically reacts with said metal powder, said metal powder including macro-agglomerates of metal particles, said metal particles having an average diameter less than about 0.1 μm and having an oxide layer that prevents contact of said particles with said oxidizer, wherein said ignition material deflagrates when the heating element is heated to a temperature of at least about 250°C..

2. The electrically actuatable igniter of claim 1 wherein the macro-agglomerates have an average diameter of about 1 μm to about 2 μm.

3. The electrically actuatable igniter of claim 1 wherein said oxidizer is selected from the group consisting of alkali metal nitrates, alkaline earth metal nitrates, alkali metal perchlorates, alkaline earth metal perchlorates, alkali metal chlorates, alkaline earth metal chlorates, ammonium perchlorates, ammonium nitrate, and mixtures thereof.

4. The electrically actuatable igniter of claim 3 wherein the oxidizer has an average particle size of about 1 μm to about 30 μm.

5. The electrically actuatable igniter of claim 1 wherein the metal powder is selected from the group consisting of electro-exploded aluminum powder, electro-exploded titanium powder, electro-exploded copper powder, electro-exploded zinc powder, and electro-exploded yttrium powder.

6. The electrically actuatable igniter of claim 5 wherein the electro-exploded metal powder is electro-exploded aluminum.

7. The electrically actuatable igniter of claim 1 wherein the electro-exploded metal powder is about 15% to about 75% by weight of the ignition material.

8. The electrically actuatable igniter of claim 1 wherein the amount of oxidizer is about 25% to about 85% by weight of the ignition material.

9. The electrically actuatable igniter of claim 1 wherein the ignition material upon ignition deflagration produces an ignition product with a temperature of about 3000°C to about 6000°C.

10. The electrically actuatable igniter of claim 1 wherein the ignition material does not thermally decompose at temperatures up to about 120°C.

11. An electrically actuatable igniter comprising:

a pair of electrodes;

a heating element electrically connected between said electrodes; and

an ignition material in contact with said heating element, said ignition material comprising an

electro-exploded metal powder and a particulate oxidizer, wherein said ignition material deflagrates when the heating element is heated to a temperature of at least about 250°C.

12. The electrically actuatable igniter of claim 11 wherein said oxidizer is selected from the group consisting of alkali metal nitrates, alkaline earth metal nitrates, alkali metal perchlorates, alkaline earth metal perchlorates, alkali metal chlorates, alkaline earth metal chlorates, ammonium perchlorate, ammonium nitrate, and mixtures thereof.

13. The electrically actuatable igniter of claim 12 wherein the oxidizer has an average particle size of about 1 μm to about 30 μm.

14. The electrically actuatable igniter of claim 11 wherein the metal powder is selected from the group consisting of electro-exploded aluminum powder, electro-exploded titanium powder, electro-exploded copper powder, electro-exploded zinc powder, and electro-exploded yttrium powder.

15. The electrically actuatable igniter of claim 11 wherein the electro-exploded metal powder is electro-exploded aluminum.

16. The electrically actuatable igniter of claim 11 wherein the electro-exploded metal powder is about 15% to about 75% by weight of the ignition material.

17. The electrically actuatable igniter of claim 11 wherein the amount of oxidizer is about 25% to about 85% by weight of the ignition material.

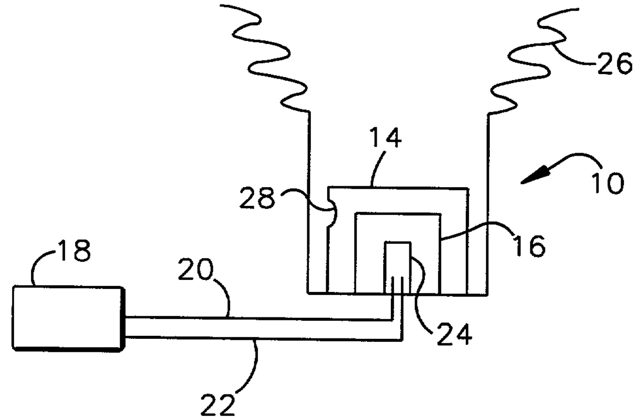
18. The electrically actuatable igniter of claim 11 wherein the ignition material upon deflagration produces an ignition product with a temperature of about 3000°C to about 6000°C.

19. The electrically actuatable igniter of claim 11 wherein the ignition material does not thermally decompose at temperatures up to about 120°C.

Abstract

An electrically actuatable igniter (24) comprises a pair of electrodes (40) and (42). A heating element (44) is electrically connected between said electrodes (40) and (42). An ignition material (48) is in contact with the heating element (44). The ignition material (48) comprises a metal powder and an oxidizer that exothermically reacts with the metal powder. The metal powder includes macro-agglomerates of metal particles. The metal particles have an average diameter less than about 0.1 μm and have an oxide layer that prevents contact of the particles with the oxidizer. The ignition material (48) deflagrates when the heating element is heated to a temperature of at least about 250°C.

Fig.1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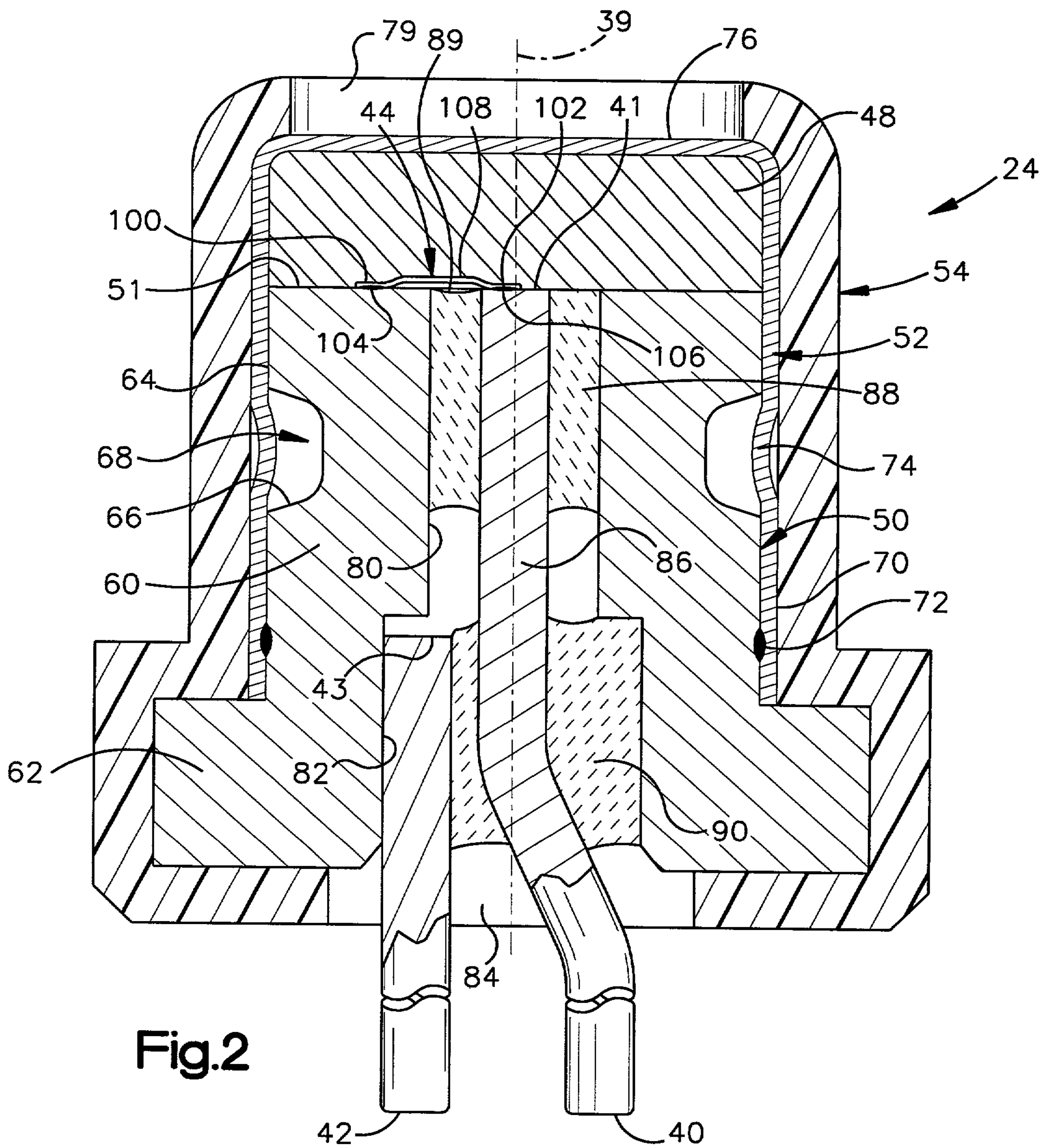
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Fig.2

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION Atty. Docket No. **TRW(VSSIM)4784**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled **IGNITION MATERIAL FOR AN IGNITER**, the specification of which

(check one) ☒ is attached hereto.
☐ was filed on ____________ as Application Serial No. ____________
and was amended on ____________ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

(Number)	(Country)	(Day/Month/Year Filed)	Priority Claimed ☐ Yes ☐ No
(Number)	(Country)	(Day/Month/Year Filed)	☐ Yes ☐ No

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a)which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	(Filing Date)	(Status-patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status-patented, pending, abandoned)

Power of Attorney: As a named inventor, I hereby appoint the following attorneys: Thomas L. Tarolli, Reg. No. 20,177; Robert B. Sundheim, Reg. No. 20,127; Calvin G. Covell, Reg. No. 24,042; Barry L. Tummino, Reg. No. 29,709; Paul E. Szabo, Reg. No. 30,429; James L. Tarolli, Reg. No. 36,029; Ronald M. Kachmarik, Reg. No. 34,512; Richard S. Wesorick, Reg. No. 40,871; Maurice R. Salada, Reg. No. 26,502; Allan W. Vogele, Reg. No. 28,127; and Gary L. Hermanson, Reg. No. 34,349; each with full powers of substitution and revocation to prosecute this application and transact all business in the United States Patent and Trademark Office connected therewith.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Inventor's signature Bryan W Shirk Date 4 AUG 2000
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Inventor's signature Timothy A. Swann Date 28.07.00

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